

Claims

What is claimed is:

- 1 1. A robot-based automation system for cryogenic crystal sample
2 mounting, for example, for use of cryogenic crystal sample mounting in the
3 x-ray crystallography station at an x-ray source, said robot-based automation
4 system comprising:
5 a robot arm;
6 a handset carried by said robot arm;
7 said handset including a pair of elongated fingers for sample
8 mounting, and
9 each finger carrying a set of strain gauge arrays for providing force
10 sensing.
- 1 2. A robot-based automation system as recited in claim 1 further
2 includes a Dewar container; said Dewar container including an ice control
3 system.
- 1 3. A robot-based automation system as recited in claim 2 wherein
2 said Dewar container includes liquid nitrogen flow control.
- 1 4. A robot-based automation system as recited in claim 1 wherein
2 said handset includes a liquid nitrogen reservoir; said reservoir carried by
3 one of said elongated fingers.

1 5. A robot-based automation system as recited in claim 1 wherein
2 said liquid nitrogen reservoir includes a check valve for filling said reservoir
3 with liquid nitrogen and a pin hole for providing a nitrogen jet flow during the
4 sample mounting and retrieval.

1 6. A robot-based automation system as recited in claim 1 further
2 includes a miniature mounting sample holder; said miniature mounting
3 sample holder includes a base member and a support member; said base
4 member and said support member having cooperating features for precision
5 positioning together.

1 7. A robot-based automation system as recited in claim 6 wherein
2 said base member includes a plurality of enlarged recesses surrounding
3 openings spaced apart around said base member.

1 8. A robot-based automation system as recited in claim 1 wherein
2 said set of strain gauge arrays includes three strain gauge arrays bonded at
3 a predefined area of each said finger.

1 9. A robot-based automation system as recited in claim 1 wherein
2 each of said strain gauge arrays has a temperature compensating bridge
3 sensing circuit configuration.

1 10. A robot-based automation system as recited in claim 1 wherein
2 said set of strain gauge arrays is used for detecting contact force intensity
3 and direction for each said finger.

1 11. A robot-based automation system as recited in claim 1 wherein
2 said set of strain gauge arrays is used for providing a precise gripping action
3 for each said finger.

1 12. A robot-based automation system as recited in claim 11
2 wherein said set of strain gauge arrays is used for providing feedback results
3 of said precise gripping action for each said finger.

1 13. A robot-based automation system as recited in claim 1 wherein
2 said robot arm has six-degree of freedom.

1 14. A robot-based automation system as recited in claim 1 includes
2 a robot arm controller coupled to said robot arm.

1 15. A robot-based automation system as recited in claim 1 includes
2 a triangular shaped sample magazine for containing a plurality of samples.

1 16. A robot-based automation system as recited in claim 15
2 includes a plurality of said triangular shaped sample magazine.

1 17. A robot-based automation system as recited in claim 1 includes
2 a controller computer coupled to said robot arm and said set of strain gauge
3 arrays.

1 18. A robot-based automation system as recited in claim 17
2 includes a video camera coupled to said controller computer.

1 19. A robot-based automation system as recited in claim 1 includes
2 a Dewar container including an ice control system coupled to said controller
3 computer.

1 20. A method for cryogenic crystal sample mounting in a robot-
2 based automation system, said method comprising the steps of:
3 providing a handset carried by a robot arm;
4 mounting the sample with a pair of elongated fingers of said handset,
5 and
6 sensing force of each finger with a set of strain gauge arrays carried
7 by each of said elongated fingers for force sensing.